STATION PAPER No. 35

MAY 1950

EFFECT OF PRESCRIBED BURNS AND SHELTERWOOD CUTTING ON REPRODUCTION OF SHORTLEAF AND PITCH PINE

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EFFECT OF PRESCRIBED BURNS AND SHELTERWOOD CUTTING ON REPRODUCTION OF SHORTLEAF AND PITCH PINES

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INTRODUCTION

PRESCRIBED FIRES have been used experimentally in the oak-pine forests of southeastern New Jersey for 13 years. The authors' purpose in writing this report is to bring some of the results of these experiments up to date.

The principles and methods of using fire as a silvicultural tool (for improving seedbed conditions and suppressing less-desirable species) have been described in

[1] STATIONED AT THE LEBANON EXPERIMENTAL FOREST, NEW LISBON, N. J., WHICH IS MAINTAINED BY THE U.S. FOREST SERVICE'S NORTHEASTERN FOREST EXPERIMENT STATION IN COOPERATION WITH THE NEW JERSEY DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT, SECTION OF FORESTRY, PARKS, AND HISTORIC SITES.

previous publications.[2] Some of the effects of prescribed fire on reproduction were outlined in these early reports. Now it is possible to evaluate the effects over a 10- to 12-year period.

This report also deals with the effect that removing part of the oak overstory has on pine reproduction. This shelterwood type of cutting was studied in combination with prescribed burning.

The purpose of these studies was to determine if it is possible to obtain prompt restocking of pines without concentrating harvest cutting and costly seedbed preparations in good seed years, which occur at intervals of 3 to 10 years.

Two series of studies were made; the first was started in 1936, the second in 1940. The areas where the studies were made have relatively poor soils. Shortleaf and pitch pines are the most valuable species here, although less-valuable oaks (the climax type) tend to usurp the sites.

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[2] LITTLE, S., AND MOORE, E. B. CONTROLLED BURNING IN SOUTH JERSEY'S OAK-PINE STANDS. JOUR. FORESTRY 43: 499-506. 1945.

LITTLE, S., ALLEN, J. P., AND MOORE, E. B. CONTROLLED BURNING AS A DUAL-PURPOSE TOOL OF FOREST MANAGEMENT IN NEW JERSEY'S PINE REGION. JOUR. FORESTRY 46: 810-819. 1948.

LITTLE, S., AND MOORE, E. B. THE ECOLOGICAL ROLE OF PRESCRIBED BURNS IN THE PINE-OAK FORESTS OF SOUTHERN NEW JERSEY. ECOLOGY 30: 223-233. 1949.

1936 STUDY

METHODS AND TREATMENTS

THE FIRST STUDY of prescribed burning in southern New Jersey included sixteen 5-acre plots in an oak-pine stand. Initial burning treatments were made on 14 plots in the winter of 1936-37; two plots were left unburned, as controls. Subsequent treatments were made at intervals of 1, 2, 3, 4, and 5 years. Other plots were scheduled for burning at intervals of 10 and 15 years. Two plots were used for each treatment.

After the winter of 1945-46, treatments were discontinued on half of each plot. On this half all overstory oaks were cut in the winter of 1946-47.

Changes in pine reproduction were tallied on fifty 1-milacre quadrats in each half plot. These quadrats were permanently marked before the plots were treated.

CHANGES IN PINE REPRODUCTION

During burning treatments

After 5 years of burning treatments, the losses of pine reproduction that had been present in 1936 were striking. On plots burned two or more times during the 5 years the fires killed about 95 percent of the seedlings that were 1.6 to 3.5 feet tall in 1936. Even though many new seedlings started on these plots, there was a net loss of

18 to 51 percent in pine seedlings of all sizes. But plots burned only once (5 years earlier) gained 100 to 200 percent in number of pine seedlings.

At the end of 10 years, the amount of pine reproduction had increased on the treated plots, usually by 600 to 700 trees per acre (table 1). For each treatment the increase was at least four times that on the unburned controls. The burning improved the seedbed conditions so much that during the 10 years the gains in reproduction greatly exceeded the losses--no matter what the interval between treatments.

After burning treatments

The effect of improved seedbed conditions was, of course, most noticeable after the burning treatments were discontinued.

However, during the first year after treatment (1946-47), logging damage also affected the changes in pine reproduction. These changes ranged from a loss of 120 pines per acre on the unburned control plots to a gain of 530 pines on the plots treated 10 times (table 1).

The loss on the control plots was due directly to logging damage. Here some of the advance reproduction was more than 3 feet tall. This was rather inflexible; it tended to break when a falling tree or a logging truck hit it.[3] Some of the smaller trees were damaged too. These losses from logging damage were not offset by new seedlings coming in, because the seedbed was generally unfavorable.

[3] TRACTORS WERE NOT USED IN LOGGING THESE PLOTS. THE HARDWOODS WERE CUT ONLY FOR CORDWOOD. THEY WERE FELLED, BUCKED UP, AND LOADED DIRECTLY ONTO TRUCKS. THE TRUCKS WERE DRIVEN OVER THE AREA, A COMMON PRACTICE ON UPLAND SITES IN THIS REGION.

Table 1.--Effect of prescribed burns and harvest cutting on pine reproduction[1]

Prescribed burning treatment			Change in pine reproduction per acre during--				Pine reproduction present in 1948
Interval between burns	Total burns	Last burn in winter of--	10-year treatment period (1936-46)	1st year after treatment period (year of logging)	2nd year after treatment period	12 years 1936-48 (total)	
Years	Number		Number	Number	Number	Number	Number
1	10	1945-46	+ 600	+530	+1,660	+2,790	3,490
2	5	1944-45	+1,790	+190	+1,970	+3,950	4,660
3	4	1945-46	+ 660	+310	+1,310	+2,280	2,570
4	3	1944-45	+ 670	+520	+1,040	+2,230	2,660
5	2	1941-42	+ 700	+ 20	+ 600	+1,320	1,480
10-15	1	1936-37	+ 600	- 25	+ 195	+ 770	1,190
Controls	0	--	+ 150	-120	+ 190	+ 220	510

[1]Mostly seedlings of pitch and shortleaf pine, but includes Virginia pines and sprout clumps of pitch and shortleaf.

The areas burned only once (10 years before logging) had a smaller amount of tall reproduction; so logging caused less damage there than on the control plots.

Areas more recently and more frequently burned had still smaller amounts of tall reproduction, but far better seedbeds. On areas burned twice (the last burn 5 years before logging) there was a gain of 20 pines per acre. But on areas burned more frequently (and within 2 years of logging), the average increase was 388 pines per acre.

The effect of improved seedbeds from repeated and recent burnings was even more apparent during the second year after the treatment period (1947-48). Then the control plots and the areas treated only once gained about 190 pines per acre. But areas burned twice gained 600; areas burned more frequently gained 1,040 to 1,970.

During 12-year period

By the end of the 12-year period, 1936-48, the areas burned once had gained 770 trees (compared to a gain of 220 on the unburned controls). Areas burned more frequently had gained 1,320 to 3,950 trees per acre.

1940 STUDY

TREATMENTS

IN 1940 A BLOCK of fourteen 1-acre plots was established in another oak-pine stand. These were set up to determine the effect of using prescribed burns annually for varying periods before removing the oak overstory. Two plots were set aside as unburned controls. On the others, a prescribed winter burn was applied 1, 2, 3, 4, 5, and 6 times before the oaks were removed. The last burn in each annual-burning series was made in the winter of 1945-46.

On half the plots, the oak overstory was thinned--during the year before burning was begun on each series--from about 1,200 stems per acre to 400 (a shelterwood cutting). On all plots, the pines were reduced to 15 seed trees per acre. The remaining oak overstory (whether previously thinned or not) was cut on half of each plot in the winter of 1946-47, and on the other half in the winter of 1948-49.

EFFECT ON REPRODUCTION

Prescribed burns

The amounts of reproduction present in late summer of 1949--4 years after the treatment period--varied according to the number of annual burns used. The unburned plots had about 580 pine seedlings per acre; plots treated once, 800; twice, 1,000; three or four times, 1,925; and five or six times, about 2,650. These are averages for the plots, regardless of thinning or time when the remaining overstory was removed.

The favorable effect from prescribed burning was due to its reducing the depth of the duff (forest floor). In 1948, 94 percent of the seedlings from the 1947 seed crop were found where the duff was no more than 1/4 inch deep. No seedlings were found where the duff was more than 1½ inches deep.

Most of the seedlings were found in spots where a film of twigs or leaf stems covered the soil (although many were found on bare mineral soil). This film offers the seed some protection from rodents and birds; later it protects the seedlings from high soil-surface temperatures. Such a film is common on areas where prescribed fires have been used.

Shelterwood cutting

Thinning the oak overstory before burning favored the establishment of pine reproduction. Where such a shelterwood cutting had been made, there was, in 1949, about 40 percent (average) more pine reproduction than in the areas where no thinning had been made before burning.

The average increase from shelterwood cutting was about the same as the average result from one prescribed burn, but was far less than that (230 to 350 percent) from three or more burns.

Logging

Some of the pine reproduction established before the final harvest cutting was lost during the year of logging. Losses in logging years were 17 percent on areas cut over in 1946-47, and 44 percent on areas cut over in 1948-49.

However, most of these losses cannot be charged to logging damage. On the areas cut over in 1946-47, the loss was only 2 percent more than the loss on uncut parts of the same plots. The loss due directly to logging damage was apparently less than 5 percent in both years. It was caused mostly by the trucks that were driven over the area.

The loss of 44 percent in 1948-49 was due mostly to two other factors. First was the dry summer of 1949. Second was the low vigor of reproduction that had been growing under an overstory.

The age of the reproduction also had a bearing on the losses during 1948-49. Seedlings that were at least 2 years old in the spring of 1949 were the most vigorous and best established; only 2 percent of them died in the areas cut over in 1946-47. But in the areas cut over in 1948-49, 28 percent of the seedlings of similar age died. One-year-old seedlings suffered more than the older ones: 22 percent died in the areas cut over in 1946-47, but 47 percent died in the areas cut over 2 years later.

Delayed final cutting of oaks

Delaying the final cutting of oaks until 1948-49 greatly increased the mortality of pine reproduction. Despite this, adequate amounts survived on some plots. (Adequate reproduction is at least 1,800 small pines per acre.)

The successful treatments used on these plots were: (1) the use of shelterwood cutting before burning, and (2) four to six successive annual prescribed burns (ending in 1945-46). The areas so treated had an average of 3,022 seedlings per acre living in the summer of 1949. Nearly all of them had started in 1948 or earlier.

But none of the other treatments on these areas just cut over gave an adequate amount of pine reproduction in 1949. All plots burned less than four times had inadequate reproduction. Such plots had only 733 pine seedlings per acre where a shelterwood cutting had been made, only 576 where a shelterwood cutting had not been made. Moreover, where no shelterwood cutting had been made, plots burned four to six times had only 1,267 pine seedlings per acre.

CONCLUSIONS

THE RESULTS of these studies confirm earlier reports on the value of prescribed fire in preparing seedbeds that favor the establishment of pine reproduction.

The amount of pine reproduction increased with the number of burns that were used. A shelterwood cutting before burning also encouraged the establishment of pine seedlings.

A few of the treatments tried provided prompt and satisfactory reproduction (at least 1,800 small pines per acre present during the first growing season after a heavy harvest cutting). In the 1936 study, the effective treatments were the use of prescribed burns at either 1- or 2-year intervals over a 10-year period, the last burn being made 1 to 2 years before harvest cutting. In the 1940 study (involving a denser stand), the effective treatments were the use of a shelterwood cutting, then four to six annual burns, followed by a final cutting 3 years after the last burn.

For obtaining prompt and adequate pine regeneration in oak-pine stands of the New Jersey pine region, these treatments are advisable, in sequence:

(1) A shelterwood cutting if the stand is dense.
(2) The use of several annual or periodic prescribed burns so that the seedbed is very favorable for the establishment of pine seedlings.
(3) After the burning treatment, delay final cutting until sufficient reproduction is already established. A few seed trees may be left during this last cutting to provide some insurance against accidental destruction of reproduction.

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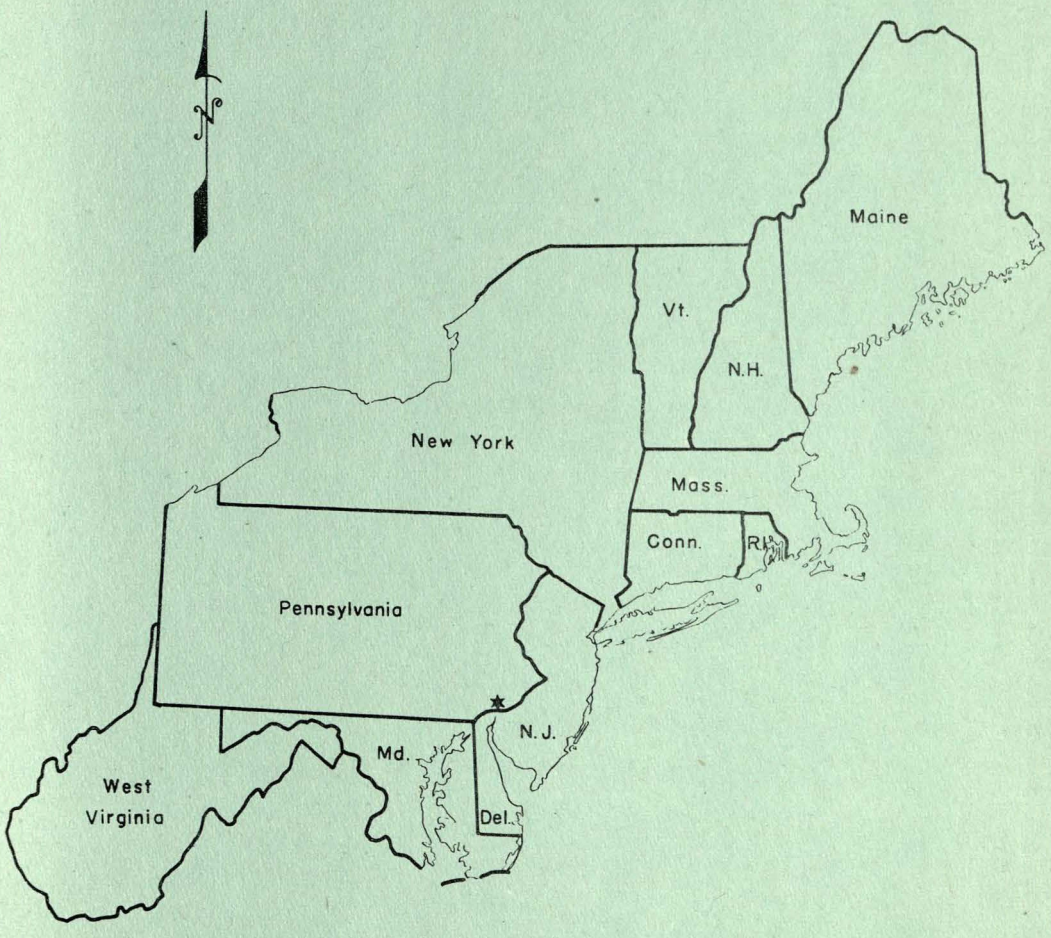

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